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Letter Position Representations in Reading: Evidence from Acquired Dyslexia

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Background

Cognitive processes that recognize written words must consider not only letter identity but also letter position. Various schemes for representing letter position in reading have been proposed, including schemes based on a letter's distance from the beginning or midpoint of the word, its role in an orthographic syllable, and its context of surrounding letters. For example, the A in CARPET might be represented as the second letter from the beginning of the word (position B+2), the nucleus of the first orthographic syllable ($N_{\sigma 1}$), the letter appearing between C and R (position C_R), or so forth.

Fischer-Baum, McCloskey and Rapp (2010) used letter perseveration errors to contrast positional schemes in spelling, arguing for a graded both-edges (beginning- plus end-based) scheme. The present study applied the same method to probe letter position representation in reading.

Methods & Results

LHD, a 70-year-old woman with left temporal and occipital damage, read aloud 1379 words. Virtually all of her 510 errors were letter substitutions (e.g., RAG → RAB). As illustrated by the trial sequence below, substituted letters were frequently (and significantly more often than expected by chance) letters that appeared in one or more of the several immediately preceding responses. For example, LHD read HILL as RILL immediately after reading RIB correctly.

Analyses of LHD's perseverations yielded conclusions very similar to those drawn by Fischer-Baum et al. (2010) for spelling. Significantly more often than expected by chance, perseverated letters occupied the same position in perseveration and prior responses, when position was defined relative to the beginning or the end of the word. For example, the substituted R in RILL appears in the same beginning-based position (B+1) as the R in the preceding response RIB; and the L in GOAL occupies the same end-based position (E-1) as the L in TURREL. Perseverated letters that did not appear in exactly matching beginning- or end-based positions were significantly more likely than expected by chance to occupy positions immediately adjacent to exact-match positions. Fully 96% of LHD's perseverations occurred at exactly- or approximately-matching beginning- or end-based positions.

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Target	*Response*
GARDEN	GARDEN
TUNNEL	TURREL
VINE	VINE
GOAT	GOAL
RIB	RIB
HILL	RILL

Discussion

These results support a both-edges scheme, in which a letter's position is encoded relative to both the beginning and the end of the word (so that the A in CARPET has position representations B+2 and E-5). The systematic tendency toward approximate as well as exact position matches suggests that the position representations are graded, with nearby positions (e.g., B+2 and B+3) having more similar representations than distant positions (e.g., B+2 and B+5). Alternative representational schemes, including midpoint-based, syllabic, and letter-context schemes, were significantly less successful in explaining the pattern of perseverations, and made no contribution beyond that of the graded both-edges scheme. These results challenge several recent theories of visual word recognition, and also suggest that the same form of letter position representation underlies both reading and spelling.

Reference

Fischer-Baum, S., McCloskey, M. & Rapp, B. (2010). The representation of letter position in spelling: Evidence from acquired dysgraphia. *Cognition*, 115, 466-490.